REMARKS

The Examiner's Office Action of August 29, 2003 has been received and its contents reviewed. Applicant would like to thank the Examiner for the consideration given to the above-identified application, and for indicating the allowance of claim 19.

By the above actions, claims 1, 4, 6, 9, 10 and 19 have been amended. Claims 1, 3, 4, 6, 9, 10, 12 and 19 are pending for consideration, of which claims 1, 4, 10 and 19 are independent. In view of these actions and the following remarks, reconsideration of this application is now requested.

Referring now to the detailed Office Action, claim 9 stands objected to under 37 C.F.R. 1.75(c), as being of improper dependent form and for failing to further limit the subject matter of a previous claim. Claim 9 was dependent from claim 13, which was newly submitted as an independent claim and was incorrectly numbered in the Amendment filed June 3, 2003. By Examiner's amendment, the newly submitted claim 13 has been corrected as claim 19. Accordingly, claim 9 has been amended, as shown above, to correct its dependency on independent claim 19. As claim 19 is allowable, its amended dependent claim 9 is also allowable.

Claims 1, 3-4 and 6 stand rejected under 35 U.S.C. §103(a) as unpatentable over Inazawa et al. (U.S. Patent No. 5,595,627 – hereafter Inazawa) in view of Zhu et al. (U.S. Patent No. 6,297,163 – hereafter Zhu). Further, claims 10 and 12 stand rejected under 35 U.S.C. 103(a) as unpatentable over Nguyen et al. (U.S. Patent No. 5,244,730 – hereafter Nguyen) in view of Mountsier et al. (U.S. Patent No. 6,184,572 – hereafter Mountsier). These rejections are respectfully traversed at least for the reasons provided below.

With respect to the rejection of claim 1, as amended, claim 1 recites a plasma processing method including the steps of:

placing a substrate inside a reaction chamber of a plasma processing system, a silicon oxide film and a resist pattern having been formed in order on the surface of the substrate;

introducing an etching gas composed of a fluorocarbon gas into the reaction chamber, the fluorocarbon gas includes carbon and fluorine, and C/F is 0.5 or more; and

creating a plasma from the etching gas and etching the silicon oxide film with the plasma and using the resist pattern as a mask,

wherein a residence time τ of the fluorocarbon gas in the reaction chamber is controlled at a value greater than 0.1 sec and equal to or less than 1 sec, so that the selectivity of the etching rate of the silicon oxide film with respect to the etching rate of the resist pattern is 2 or more, the residence time τ being given by P x V/Q, where P is a pressure (unit: Pa) of the fluorocarbon gas, V is a volume (unit: L) of the reaction chamber and Q is a flow rate (unit: Pa · L/sec) of the fluorocarbon gas.

Turning now to the cited prior art references, Inazawa teaches using a compound gas such as C_4F_8+CO+Ar, which includes a fluorocarbon gas of which C/F is 0.5 or more and other gases, and etching SiO_2 using a resist as a mask. Inazawa further discloses that the etching selection ratio SiO_2/SiN can be controlled by controlling the residence time of the compound gas in a reaction chamber of a plasma processing system at a predetermined value (see column 7, lines 17-25 and Figs. 4 and 5).

According to Inazawa, the etching selection ratio of SiO_2/SiN (the underlayer film of the SiO_2 film) is controlled at a high predetermined value to avoid problems during the forming of a self-align contact. However, Inazawa fails to disclose controlling the etching selection ratio of SiO_2/resist. Specifically, Inazawa fails to disclose or suggest controlling the selectivity of the etching rate of the silicon oxide film with respect to the etching rate of the resist pattern by controlling the residence time, and controlling the selectivity between the etching rates at 2 or more by controlling the residence time within a predetermined range, such as in the invention of the amended claim 1. Hence, amended claim 1 of the present invention distinguishes over Inazawa.

Zhu teaches using a gas such as C_5F_8 or C_4P_8, which includes a fluorocarbon gas of which C/F is 0.5 or more, for etching a silicon oxide film (see column 5, lines 9-12, and column 6, line 66 to column 7, line 1), and achieving a desirable selectivity between the etching rates of a photo resist and an insulating material, such as a silicon oxide film.

According to Zhu, in order to achieve the predetermined selectivity between the etching rates of the silicon oxide film and the resist, CO is added to the gas including the fluorocarbon gas of which C/F is 0.5 or more (see column 6, lines 14-17), and the selectivity can be controlled by controlling the amount of CO added (see column 6, lines 35-44). This feature is different from that of the amended claim 1.

Applicant respectfully asserts that, similar to Inazawa, Zhu also fails to disclose or suggest controlling the selectivity of the etching rate of the silicon oxide film with respect to the etching rate of the resist pattern by controlling the residence time of the gas included in the fluorocarbon gas, and controlling the selectivity between the etching rates at 2 or more by controlling the residence time within a predetermined range, such as recited in amended claim 1 of the present invention.

With respect to the rejection of claim 4, as amended, claim 4 recites a plasma processing method including the steps of:

placing a substrate inside a reaction chamber of a plasma processing system, a silicon oxide film having been formed on the surface of the substrate;

introducing an etching gas composed of a fluorocarbon gas into the reaction chamber, the fluorocarbon gas includes carbon, and C/F is 0.5 or more; and

creating a plasma from the etching gas and etching the silicon oxide film with the plasma and using the resist pattern as a mask,

wherein a parameter $E = P \times W_0/Q$ (P is a pressure (unit: Pa) of the fluorocarbon gas, W_0 is a magnitude (unit: W) of the power applied to create the plasma and Q is a flow rate (unit: Pa · L/sec) of the fluorocarbon gas) is controlled at a value greater than 0.8×10^4 sec · W/m^3 and equal to or less than 8×10^4 sec · W/m^3, so that the selectivity of the etching rate of the silicon oxide film with respect to the etching rate of the resist pattern is 2 or more, without considering the volume of the reaction chamber in the plasma processing system.

Turning now to the cited prior art references, Inazawa not only fails to disclose controlling the parameter $E = P \times W_0/Q$ at a specific range of greater than 0.8×10^4 sec · W/m^3 and equal to or less than 8×10^4 sec · W/m^3, but also fails to disclose controlling the parameter E, which is composed of P, W_0 and Q, to increase the selectivity of the etching rate without considering the volume of the reaction chamber in the plasma processing system. Furthermore, according to Inazawa, since the residence time of the etching process is being controlled, the volume of the reaction chamber is being considered (see column 7, lines 17-25).

The Examiner asserts that although Inazawa fails to disclose the range of the parameter E, in the case where the parameter E, which is a general condition (concept), being disclosed in the prior art, the range of the parameter E would be obvious to one skilled in the

art. However, it is respectfully submitted that the parameter E recited in amended claim 4 is not disclosed in the prior art of the present invention or in Inazawa, but was discovered by the Applicant of the present invention.

As stated by the Examiner, Inazawa teaches, in column 8, lines 36-42, a predetermined gas pressure for a reaction chamber, a flow rate of a gas including fluorocarbon gas, and setting an RF voltage. However, Inazawa completely fails to disclose or suggest the formula for parameter E. Without any disclosure, suggestion, or motivation, the formula for parameter E would not be obvious to one skilled in the art, even with the above features being disclosed.

Zhu teaches etching a silicon oxide film using a compound gas, in which CO is added to a fluorocarbon gas of which C/F is 0.5 or more, to achieve a desirable selectivity between the etching rates of a resist and the silicon oxide film. However, Zhu fails to disclose or suggest the parameter E and the controlling of the selectivity of the etching rate of the silicon oxide film with respect to the etching rate of the resist at 2 or more by controlling the parameter E as recited in amended claim 4.

With respect to the rejection of claim 10, as amended, claim 10 recites a plasma processing method comprising the steps of:

placing a substrate inside a reaction chamber of a plasma processing system;

introducing a fluorocarbon gas into the reaction chamber, the fluorocarbon gas includes carbon and fluorine, and C/F is 0.5 or more; and

creating a plasma from the fluorocarbon gas and depositing an organic film on the substrate using the plasma,

wherein a parameter $E = P \times W_0/Q$ (P is a pressure (unit: Pa) of the fluorocarbon gas, W_0 is a magnitude (unit: W) of the power applied to create the plasma and Q is a flow rate (unit: $Pa \cdot L/sec$) of the fluorocarbon gas) is controlled at 0.8×10^4 sec $\cdot$ W/m^3 or less, without considering the volume of the reaction chamber in the plasma processing system.

Turning now to the cited prior art references, Nguyen teaches a plasma process of depositing an organic film using a fluorocarbon gas, such as C_4F_8, of which C/F is within 0.5 and 1. Nguyen further discloses that when depositing the organic film, the density of the RF power is controlled, together with the residence time of the fluorocarbon gas, at a predetermined value of 0.05 to 0.4 W/cm^2, but the two parameters are controlled separately

(see column 4, lines 49-59). Hence, Nguyen completely fails to disclose the features of amended claim 10, such as controlling the deposition rate of the organic film based on the parameter $E = P \times W_0/Q$, and controlling the deposition rate of the organic film based on the parameter E without considering the volume of the reaction chamber in the plasma processing system.

Nguyen also teaches controlling the residence time of the fluorocarbon gas at approximately 0.9 sec., and independently setting the components composing the parameter E of the present invention, such as the pressure of the fluorocarbon gas (see column 4, lines 56-59), the gas flow (see column 4, lines 39-42) and the magnitude of the power (see column 4, lines 49-53). However, Nguyen completely fails to disclose the parameter $E = P \times W_0/Q$, and controlling the deposition rate of the organic film by controlling the value of E in a specific range without considering the volume of the reaction chamber, as recited in amended claim 10.

The Examiner asserts that the composition of parameter E from the gas pressure, the flow rate and the power are obvious to one skilled in the art. However, since Nguyen completely fails to disclose about the parameter E, the composition of the parameter E from the gas pressure, the flow rate and the power would not obvious to one skilled in the art.

Mountsier teaches a plasma process of depositing an organic film using a fluorocarbon gas, such as C_6F_6, of which C/F is within 0.5 and 1. However, Mountsier completely fails to disclose or suggest the feature of amended claim 10, such as controlling the deposition rate of the organic film by controlling the parameter $E = P \times W_0/Q$ at 0.8×10^4 sec $\cdot$ W/m^3 or less, without considering the volume of the reaction chamber in the plasma processing system.

The requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the reference themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations.

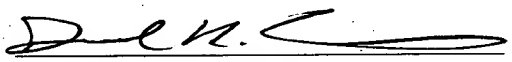
As Inazawa and Zhu fail to disclose or suggest controlling the selectivity of the etching rate of the silicon oxide film with respect to the etching rate of the resist pattern by

controlling the residence time, and controlling the selectivity between the etching rates at 2 or more by controlling the residence time within a predetermined range, and as Nguyen and Mountsier completely fail to disclose the parameter $E = P \times W_0/Q$, and controlling the deposition rate of the organic film by controlling the value of E in a specific range without considering the volume of the reaction chamber, the §103(a) rejections of claims 1, 2-4, 6, 10 and 12 are improper.

In view of the amendments and arguments set forth above, Applicant respectfully requests reconsideration and withdrawal of all the pending rejections.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicant's representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby by expedited.

Respectfully submitted,



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